CLAIMS

[0057] What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A memory cell comprising:

a chalcogenide glass doped with a metal, said chalcogenide glass having a stoichiometry and a maxium allowable amount of metal dopant which causes said chalcogenide glass to remain in a glass forming region;

a first electrode and a second electrode in contact with said chalcogenide glass; and

a dendrite formed between said first and second electrodes when voltage is applied to said first and second electrodes.

2. The memory cell of claim 1, wherein said chalcogenide glass has a glass transition temperature which is about or higher than the highest temperature used in the formation and packaging of a memory device containing said memory cell.

3. The memory cell of claim 1, wherein said chalcogenide glass comprises a material selected from the group consisting of oxygen, sulfur, tellurium and selenium.

4. The memory cell of claim 3, wherein said chalcogenide glass comprises oxygen.

5. The memory cell of claim 3, wherein said chalcogenide glass comprises sulfur.

6. The memory cell of claim 3, wherein said chalcogenide glass comprises tellurium.

7. The memory cell of claim 3, wherein said chalcogenide glass comprises selenium.

8. The memory cell of claim 1, wherein said metal is selected from the group consisting of silver, copper, platinum, gold, cadmium, ruthenium, cobalt, zinc, chromium, maganese and nickel.

9. The memory cell of claim 1, wherein said chalcogenide glass is a germanium selenide glass.

10. The memory cell of claim 9, wherein said chalcogenide glass is a germanium selenide glass doped with silver.

11. A non-volatile memory cell comprising:

a germanium selenide glass doped with silver, said silver doping being in a concentration which maintains said germanium selenide glass in the glass forming region;

a first electrode and a second electrode in contact with said doped germanium selenide glass; and

a dendrite formed between said first and second electrodes when voltage is applied to said first and second electrodes.

12. The non-volatile memory cell of claim 11, wherein said germanium selenide glass has a glass transition temperature which is about or higher than the highest temperature used in the fabrication and packaging of a memory device containing said non-volatile memory cell.

13. The non-volatile memory cell of claim 11, wherein said germanium selenide glass comprises a material having the formula $(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$.

14. The non-volatile memory cell of claim 13, wherein y_1 represents a silver atomic percentage which is less than or equal to that which approximately satisfies equation $y_1 = 19 + 15 * \sin[0.217*x_1 + 3.23]$.

15. The non-volatile memory cell of claim 11, wherein said germanium selenide glass comprises a material having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$.

16. The non-volatile memory cell of claim 15, wherein y_2 represents a silver atomic percentage which is less than or equal to that which approximately satisfies equation $y_2 = 21 - 11.5 * \exp[-(\ln(x_2/44.4)/ (0.84)^2)]$.

17. A chalcogenide glass material having the formula $(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region.

18. The chalcogenide glass material of claim 17, wherein $x_1 = 23$.

19. The chalcogenide glass material of claim 17, wherein $x_1 = 25$.

20. The chalcogenide glass material of claim 17, wherein $x_1 = 20$.

21. The chalcogenide glass material of claim 17, wherein y_1 represents a silver atomic percentage which is less than or equal to that which approximately satisfies equation $y_1 = 19 + 15 * \sin[0.217 * x_1 + 3.23]$.

22. A chalcogenide glass material having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region.

23. The chalcogenide glass material of claim 22, wherein y_2 represents a silver atomic percentage which is less than or equal to that which approximately satisfies equation $y_2 = 21 - 11.5 * \exp[-(\ln(x_2/44.4)/(0.84)^2)]$.

24. A memory cell comprising:

a germanium selenide glass having the formula $(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region; and,

at least two electrodes in contact with said germanium selenide glass, said germanium selenide glass forming a dendrite between at least two electrodes in response to a voltage applied across said at least two electrodes.

25. A memory cell comprising:

a germanium selenide glass having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region ; and

at least two electrodes in contact with said germanium selenide glass, said germanium selenide glass forming a dendrite between at least two electrodes in response to a voltage applied across said at least two electrodes.

26. A method of forming a memory cell comprising the steps of:

providing a chalcogenide glass over a substrate;

doping said chalcogenide glass with a metal to form a doped chalcogenide glass, said doped chalcogenide glass having a stoichiometry which causes said doped chalcogenide glass to be in a glass forming region, said doped chalcogenide glass having a glass transition temperature which is about or higher than the highest temperature used in the formation and packaging of a memory device containing said memory cell; and,

forming a plurality of electrodes in contact with said doped chalcogenide glass.

27. A method of forming a memory cell comprising the steps of:

providing a germanium selenide glass having the formula $(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$ over a substrate, and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region; and,

forming at least two electrodes in contact with said germanium selenide glass at locations which permit said glass to transition between high and low resistance states in response to signals applied to said electrodes.

28. The method of claim 27, wherein x_1=23.

29. The method of claim 27, wherein x_1=25.

30. The method of claim 27, wherein x_1=20.

31. A method of forming a memory cell comprising the steps of:

providing a germanium selenide glass having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region; and,

forming at least two electrodes in contact with said germanium selenide glass at locations which permit said glass to transition between high and low resistance states in response to signals applied to said electrodes.

32. A method of operating a memory cell comprising the steps of:

applying a voltage across a germanium selenide glass having the formula $(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region, to change the resistance state of said glass.

33. The method of claim 32, wherein x_1=23.

34. The method of claim 32, wherein x_1=25.

35. The method of claim 32, wherein x_1=20.

36. A method of operating a memory cell comprising the steps of:

applying a voltage across a germanium selenide glass having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region, to change the resistance state of said glass.

37. A processor system comprising:

a processor; and

an integrated circuit coupled to said processor, at least one of said processor and integrated circuit including a memory cell, said memory cell comprising:

a germanium selenide glass having the formula$(Ge_{x1}Se_{1-x1})_{1-y1}Ag_{y1}$, wherein $18 \leq x_1 \leq 28$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region; and

at least two electrodes in contact with said doped germanium selenide glass, said germanium selenide glass changing a resistance state in response to application of a voltage across said at least two electrodes.

38. The processor system of claim 37, wherein said processor and said integrated circuit are integrated on same chip.

39. The processor system of claim 37, wherein x_1=23.

40. The processor system of claim 37, wherein x_1=25.

41. The processor system of claim 37, wherein x_1=20.

42. A processor system comprising:

a processor; and

an integrated circuit coupled to said processor, at least one of said processor and integrated circuit including a memory cell, said memory cell comprising:

a germanium selenide glass having the formula $(Ge_{x2}Se_{1-x2})_{1-y2}Ag_{y2}$, wherein $39 \leq x_2 \leq 42$ and wherein said silver is in a concentration which maintains said germanium selenide glass in the glass forming region; and

at least two electrodes in contact with said doped germanium selenide glass, said germanium selenide glass changing a resistance state in response to application of a voltage across said at least two electrodes.

43. The processor-based system of claim 42, wherein said processor and said integrated circuit are integrated on same chip.